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Analysis of the Requirements Refinement Process Used at the JNTF

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Master of Engineering in Space Operations

ABSTRACT

The objective of this project was to evaluate and make recommendations for improving existing procedures for the Joint National Test Facility (JNTF) engineering process. The research focused on the JNTF project managers process for requirements refinement. Background was provided by a review of the JNTF DIRECTIVE NO. 4200, which outlines the processing of JNTF Task Orders. Some parts of the JNTF Systems Engineering Management Plan (SEMP) were also reviewed. Data were provided by interviews of seven out of a possible twenty JNTF project managers. The data collected from the project managers is the basis for the recommendations made. The survey information is organized using a three P analysis. The three Ps are Preparation, Payoff, and Performance. The principal recommendations for improvement are listed below:

- The primary recommendation is that the JNTF develop and implement a Project Manager Certification Program. Part of this certification program should include attendance by all project managers at the Defense Systems Management College (DSMC) acquisition 101 or an equivalent course.
- The JNTF SEMP needs to be evaluated for its usefulness and then appropriate action should be taken to revise the SEMP continually or discontinue use of the SEMP.
- Project manager communication needs to be improved to reduce redundancy at the JNTF.
- The Requirements Correlation Matrix should be used to track the progression of requirements throughout a projects lifecycle.
- All integral personnel need to be involved at every critical step to make the process more efficient.

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Background

The objective of this project was to evaluate and make recommendations for improving existing procedures for the Joint National Test Facility (JNTF) engineering process. The area affected is the JNTF with emphasis on project manager (PM) actions and tasks for requirements processing. The JNTF suffers from reluctance to adhere to documented engineering processes by the government project leads (project managers). Some of the project managers interviewed managed: War Game 2000, Studies and Analysis, Technology Insertion, Simulation Support Center, Exercise Support, and Software Engineering.

Introduction

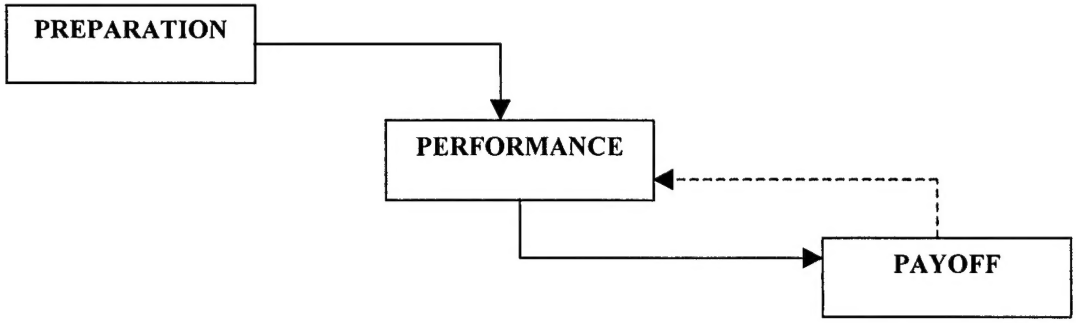
The tasks required for this research project were:

1. Evaluate present engineering processes used by government project managers with associated metrics (specifically the method to go from customer idea to requirements).
2. Provide improvement suggestions to better meet the needs of the government.
3. Provide a method to track requirements throughout a projects lifecycle.

Task number one was done by reviewing the JNTF Directive number 4200, reviewing parts of the JNTF Systems Engineering Management Plan, and interviewing some of the JNTF project managers. Task number two, providing suggestions for improvement, is done throughout this paper and summed up in the conclusions. I will make a recommendation for task number three in the performance section of this paper.

3 P Analysis

The three P's are Preparation, Performance, and Payoff. The following diagram shows the interaction between the three P's.



Preparation feeds into performance, and performance feeds into payoff. Payoff also feeds into performance, because knowing your payoff can improve your performance. **Preparation** includes; project manager training and certification, references available to the project managers, and each project manager's personal background. **Payoff** is the incentive to work hard and includes job satisfaction, recognition for good work, and a good reputation for the JNTF. **Performance** is a measure of the project manager's effort and is based on meeting the customer's requirements. A survey was used to collect information from seven of the twenty project managers at the JNTF. Note: In one of the PM interviews I did not get to three of the questions. The survey results constitute a majority of this paper and lead to the solutions recommended. I used the 3 P analysis to organize the results of the survey. I have underlined each of the survey questions and included them under one of the three P's. After some of the questions recommendations for improvement are given.

PREPARATION

I am starting the preparation section with a discussion of the two JNTF documents I reviewed to gain an understanding of the processes that are used at the JNTF. I reviewed the JNTF DIRECTIVE NO. 4200, which outlines the processing of Joint National Test Facility Task Orders. A task order is "a document that identifies the

specific tasks, products, schedules, and technical approach which is jointly prepared by the Government and the Contractors." [1]

I also reviewed parts of the JNTF Systems Engineering Management Plan (SEMP) Contract Data Requirements List (CDRL) A078-002B from 2 April 1996. The JNTF "...(SEMP) (CDRL A078) defines the engineering process used at the JNTF. It describes the roles and responsibilities for coordinating and integrating JNTF efforts in requirements definition, design, development, test, logistics, operations, and maintenance to attain engineering goals of performance, cost, and schedule in support of JNTF customer needs." [2] Another quote that further describes the SEMP is, "The SEMP defines the processes, procedures, engineering techniques, technical disciplines, and organizational interfaces utilized by the Government and contractors to develop and support the evolving requirements of existing and new programs at the JNTF." [2] The Table of Contents from the SEMP can be found in appendix A.

Do you feel that you were properly trained to be a project manager? If not, what type of training should be implemented?

The majority of the project managers interviewed felt that they were not properly trained to be project managers. Currently the JNTF is offering monthly project manager training on subjects including finance, task orders, and award fee assessment. The courses are on tape and the instructors are JNTF employees who are the experts from the particular area at the JNTF. There are currently 10 tapes and new topics can be added as needed. A copy of the spreadsheet that outlines the courses offered is included in appendix B. The spreadsheet was e-mailed to me by Mr. Fred Ehlers from the JNTF.

This monthly training does not go over the details of working with operations or engineering.

The Joint National Test Facility's Organization and Functions Manual from 12 Jan 1998, has a section on page 9 about a Plans and Requirements (CIX) group. One of the duties for the CIX group states, "Manage JNTF Project Management Program (Project Manager Checklist, Handbook, and Training Program). Manage the Project Manager Certification Program." The CIX group is currently filled by two JNTF Advisory and Assistance Services (NAAS) contractors. I posed questions about these duties of the CIX group to Mr. Vic McMillen, who works at the JNTF and is part of the Requirements Definition Working Group. I found that the Project Manager Checklist from May 7, 1996 is currently being revised. The Project Manager Handbook is not currently being developed. The Project Manager Training Program is, "currently a part of the Contracting Officer Representative (COR) training which all project managers have to attend." [3] "The COR is appointed by the Procuring Contracting Officer (PCO) and is the senior government representative who, together with the PCO, is responsible for surveillance and assessment of contractor performance on the contract." [1] The PCO is responsible for contract actions. [1] The Project Manager Certification Program is, "Not currently under development and will have to be reconsidered as a need before development begins." [3] The COR training mentioned above is now called project manager training. [4]

Recommendations: The project manager certification program should be developed and implemented. Without a list of requirements to become a project manager it is very difficult to get a potential project manager to accomplish the "suggested" items.

Project managers should be consulted to find out what resources would be useful, and these resources should be provided. Part of the project manager certification should include a formal acquisition course. I recommend a course offered by the Defense Systems Management College (DSMC). The mission of the DSMC is to, "**promote and support** the adoption and practice of sound systems management principles by the acquisition work force through education and training, research, consulting, and information dissemination." [5] "DSMC is part of the **Defense Acquisition University** (DAU), which was established in 1992, and is a consortium of 15 Department of Defense (DOD) education and training institutions." [5] The course that I believe would be the most beneficial to the project managers at the JNTF is ACQ 101 Fundamentals of Systems Acquisition Management. [6] "This course provides an overview of the DOD systems acquisition process including the basics of system acquisition program management and the developmental life cycle of a system from inception to disposal. The course covers and integrates system concept exploration, development, production, and fielding/deployment using examples and case studies from the DOD acquisition organizations, DOD resource allocation processes, contemporary issues in acquisition, and details of the phases of system developments. Discussions are conducted on requirements generation, DOD 5000 series, procedures, documentation, and current issues. The course concludes with an acquisition strategy workshop that integrates all the course material." [6] The eight class day ACQ 101 course is intended "...for individuals who have little or no experience in DOD acquisition management. It has proved very useful to personnel in headquarters, program management, functional or support offices, and industry partners." [6] There are no prerequisites for ACQ 101. [6] This course is

available several times each month at various locations around the country. [7] It will be offered at Peterson AFB from 25 August 1998 through 3 September 1998. [7] The schedule for ACQ 101 classes that start in June 1998, July 1998, and August 1998 is provided in Appendix C. [7]

ACQ 201 Intermediate Systems Acquisition would be recommended for project managers who have already taken ACQ 101. "For contracting personnel, the prerequisites are ACQ 101, or a combination of CON 202, CON 204 and CON 210." [6] ACQ 201 is a fourteen class day course intended for students with two to four years experience. [6] "Eighty percent of the students who attend have less than 10 years of experience." [6] "Course attendees are civilian employees and active duty service people from almost all of the DAWIA career paths." [6] DAWIA is an acronym for Defense Acquisition Workforce Improvements Act. [8] The course description for ACQ 201 is; "This course provides journeymen students from the DAWIA functional career paths a comprehensive and integrated view of the DOD systems acquisition management, technical and business processes. They become acquainted with the specialized terminology, concerns, policies, and roles of the primary acquisition participants. Students develop into practitioners, better prepared to cooperate in a multifunctional, synergistic environment. They are ready to accept the empowerment necessary to implement the concepts of integrated product and process development while working in program integrated product teams." [6] The ACQ 201 will be offered at Peterson AFB from 28 July 1998 through 14 August 1998. [7] A schedule for ACQ 201 classes that start in June 1998, July 1998, and August 1998 is also provided in Appendix C. [7] The dates and the FULL/NOT FULL status of the classes in both of the class schedules are

accurate as of 13 April 1998. The Peterson AFB 25 August 1998 to 3 September 1998 ACQ 101 course will be available over satellite and the Peterson AFB 28 July 1998 to 14 August 1998 ACQ 201 will have an on-site instructor. The point of contact at Peterson Air Force Base for these courses is Ray Baldner (556-2025). Mr. Baldner has enough people to fill the courses at Peterson, but depending on factors like Temporary Duty (TDY) there may be openings. Personnel in Acquisition Professional Development Program (APDP) coded positions have priority in taking the courses. [8] Normally only people in APDP coded positions will have the TDY paid for but at the end of the year people in un-coded positions may be picked up. [8] There is no charge for the courses whether you are in a coded or un-coded position. [8] The four schools that instruct the courses are the: Defense Systems Management College (DSMC), Air Force Institute of Technology (AFIT), Navy College of Acquisition Training (NCAT), and Army Logistics Management College (ALMC). [7] [8] Any personnel can go to a course taught by any of the four schools. [8] To get in a course at a base other than Peterson Mr. Matt Benavides can be contacted at Randolph Air Force Base, DSN (487-6580). [8] These courses will be available on the web as self study in late Summer 1998 or early Fall 1998. [8]

What documents do you use as references in your work as a Project Manager?

Project managers demonstrated significant differences in their responses, all or part of each project managers answer is below:

- "Directive 4200. Preliminary briefings from sponsor/customer."
- "None, could count Directive 4200, Project Manager Checklist rarely referenced."
- "Developed a checklist to see what the customer needs."

- "The "Reynolds Report", Previous version of the DO, Cost and performance data from finance (JNTF/POF),..."
- "Forms available on the common server (Mogli) to do EE's, METOs, etc..." Engineering Estimates (EE), Minimum Effort Task Orders (METO)
- "Primarily Directive 4200 and the Systems Engineering Management Plan (SEMP) DoD 5000.1 and 2." Uses the web to obtain background information.
- A personal reference called "Object Solutions", does not use anything internal to the JNTF.

The Definition of the Delivery Order (DO) is, "Contract vehicle for each project with mini-Statement of Work specific to that project...embodies the totality of each project from a requirements perspective. Stand alone document drafted and coordinated by each PM to get 'their' work on contract." [9] The Reynolds Report is a, "Report generated as a result of an academic audit of the 'then' technology modernization strategy in Jan 96. Key points were not to focus so hard on the technology, but to invest in more expertise in contemporary modeling and simulation methods. Also included very strong recommendations to pursue distributed computing." [9] The most commonly used reference is Directive 4200. Directive 4200 is a fairly short, user friendly document that tells you only what you need to know. Directive 4200 is a good model for the type of document that is helpful to the project managers.

A group at the JNTF is currently evaluating the JNTF Overall Requirements Process. Once this group has implemented its solutions, the project manager checklist should be revised to reflect the changes. The Project Manager Checklist should be reviewed every six months and kept current so that it remains a useful tool at all times.

Do you use Directive 4200 as a reference in your work as a project manager?

As described earlier Directive 4200 is the document that describes the, "Processing of Joint National Test Facility Task Orders." [1] Some of the project managers use Directive 4200 very little and others responded that they do follow it. Directive 4200 was recently revised and now may be more useful to all of the project managers. One of the project managers feels that the examples are the most important part of the document and that real examples should be added to Directive 4200.

Do you use the Systems Engineering Management Plan (SEMP) CDRL A078-002 B, 2 April 1996, as a reference in your work as a project manager?

Some of the answers included, "Never", "No, did not know it existed", "No, it is inaccurate, never used it", "Not often", and "Yes, Can be applicable for a common understanding, some definitions, probably needs to be updated." The consensus was that the SEMP is a long (about 150 pages) outdated document that is used very little. One project manager said a document longer than 20 to 30 pages is too long. Another project manager feels that the SEMP should be updated yearly.

Recommendations: It is my understanding that a SEMP is usually created for a particular project and not intended to cover all of the projects like the JNTF's current SEMP. This may be one of the reasons that the JNTF's current SEMP is used so little. I suggest modeling the SEMP after the Electronic Industries Association/Interim Standard-632. [10] An example Table of Contents that follows EIA/IS-632 is included in appendix D. [11] Also the SEMP should be shortened and then kept current through a yearly update by one person in charge of the revision. If the effort and cost required to maintain the SEMP cannot be justified by the personnel who would use it, then I would discontinue using the SEMP.

PAYOFF

What do you like about your job as a project manager?

Project mangers answered with excitement about their jobs with statements such as: "technically challenging", "exciting", "allowed quite a bit of control and opportunity", "given responsibility to make it happen". Overall the project managers that were interviewed appear to like their jobs. They seem to feel empowered and in control of the work they are doing.

What don't you like about your job as a project manager?

Project managers gave several reasons for discontentment with their current duties:

- "Corporate support is poor for the PMs"
- "Time consuming, labor intensive"
- "No one in the JNTF understands at the high-level how the processes fit together" (engineering and contract)
- "Very little recognition of effective PMs given by the organization"
- "High work load"
- "Difficult to manage a large team (approximately 35 people)"
- "Lack of concentrated focus and long-range planning"
- "PMs reluctant to share information with other PMs (need to prove the value added in coordination)"
- "No strong incentives for PMs to work together"
- "Huge amount of time to get a $1K or $400K project on contract, time and effort should correlate to the dollars"

- "We are not able to act as a "business" but there is increasing pressure to perform more corporately"

Recommendations: Project managers should meet weekly to share information and give up-dates on their projects. Activities should be set up for team building; this may improve communication between the project managers. An effort should be made by the project manager supervisors to publicly recognize exceptional work by the project managers.

PERFORMANCE

What are your responsibilities as a JNTF project manager?

Project Managers indicated their responsibilities as: defining the requirements with the customer, planning a budget, getting the dollars in, overseeing the project and timeline, requirement coordination with contractors. Essentially the project manager must define the requirements with the customer, pass the requirements on to the contractors that are going to do the work, oversee all aspects of the project and make sure that the customer's requirements are completed. This process seems fairly straightforward, but in practice it can be very complicated and time-consuming. Depending on the project that is being worked and who the customer is, getting the requirements written down may be difficult.

Who is involved in the requirement definition process?

Most of the project managers identified the participants in the requirements definition process as the customer, contractors, and the project manager. Some of the other people mentioned were; JNTF Advisory Assistance Services (NAAS) support, JNTF staff, and the sponsor.

How do you define the requirements for a project?

One project manager says they, "Start with idea, work with customer to develop high level approach." Different project managers used a variety of different terminology for describing the steps in the process including: A-spec, Operational Concept document, working groups, configuration change board, In-Process Review, business plan, and Integrated Product Teams.

Recommendations: The project managers should meet and talk about the steps they use and decide on the most efficient process and then use the same terminology to describe the steps. A standard process with standard terminology would make communication among all of the people involved easier. Because the project managers all have different projects with different types of customers, it may be hard to standardize the process. An attempt should be made to find a process that fits the majority of the projects and the others can adapt the process to fit their project.

One item which seems essential is the Operational Concept Document (OCD). From the OCD, Measures of Effectiveness, Environments, and Constraints will flow one of three documents. They are listed here in order of increasing detail required to write them: Operational Requirements Document (ORD), Capstone Requirements Document (CRD), Functional Requirements Document (FRD). At a minimum the ORD must be written. I have included in appendix E two attachments from Air Force Instruction (AFI) 10-601 31 May 1994 (Operations) "Mission Needs and Operational Requirements Guidance and Procedures". [12] Attachment 7 from AFI 10-601 Describes the ORD (Procedures and Format). [12] Attachment 8 from AFI 10-601 describes the ORD Requirements Correlation Matrix (RCM) (Procedures and Format). [12] I suggest using

the RCM as the tool to keep track of the project requirements and the changes to the requirements throughout the projects lifecycle.

One of the project managers talked about a "wailing & grinding of teeth" between the project manager and the contractors. To avoid this problem the contractors should be involved in the requirements refinement process. The first meeting between the customer and the project manager should also include the contractors that will be involved.

In the requirement definition process are only requirements written down, or are solutions included in the list also?

It seems that a common problem for all people involved in requirements definition is that solutions are thought of before a requirement is written down. If this occurs then, the actual requirement may never be defined. Some of the project managers said that solutions were not put down in the requirements definition process, and some said that solutions were included sometimes. One project manager said, "It's only natural to have a preconceived notion of the solution." Another project manager said, "Sometimes possible solutions are looked at for cost or interface considerations."

Recommendations: Even with the temptation to come up with solutions early in the process, it is better to wait so that no ideas are lost because a solution has already been defined.

Who is/are your customer(s) and how much do they participate in the project?

As might be expected, project managers had their own specific customers. Some of the customers included: Ballistic Missile Defense Organization (BMDO), United States Space Command, Air Force Space Command, JNTF projects and project managers. The levels of participation by the customers varied from not enough

participation to too much participation. I would say that a highly interactive relationship between the customer and the project manager is better than not enough interaction.

What would you change about the process used by the Project Managers, and how would you change it?

Most of the project managers had a lot to say in their response to this question.

- "Recommend anything that would speed up process, need to streamline it, too many people involved, cut down the number of people but would require an un-biased mediator who is not associated with the projects and not affected by the dollars. Better off tracking performance rather than trying to have perfect descriptions."

- "Process should be defined better by using possibly continuity folders, which currently are not used, and use a program manager checklist."

- "Need a better division of labor. Better job of getting justifiable requirements in the hands of people doing long term planning."

- "I would Force top level policies to be drafted and enforce that require PMs to coordinate their efforts more effectively and use a single, highly visible requirements process that would facilitate a more "corporate" solution instead of Stove-piping. I would also require periodic reviews for governments and contractors to get greater visibility into the projects' critical objectives, progress, and issues."

- "Make the process more standardized with more influence based on management requirements instead of strictly following government contractual desires. Force standardization and follow-up to ensure they are managing consistently. Reaffirming centralized control and accountability would go a long way. Money does not flow through management channels."

- The amount of time and resources used to work with the customer trying to get buy-in early, to date, is mostly self-imposed.

- "Have already started to change in the department, set aside a group whose primary job is requirements definition (not his developer). Would take BMDO/TOM out of requirement definition process allow JNTF to manage process not have BMDO/TOM involved."

It seems like more centralized control is needed. The JNTF group working on requirements appears to favor this approach. Notes from one of their meetings refer to

using the Deputy Commander for Customer Integration (JNTF/CI) as the single entry point for all requirements to the JNTF.

What do you like about the process used by the project managers?

Some of the benefits the project managers found with the current process are cited below.

- "Open process freedom"
- "We do eventually get stuff on contract and projects completed"
- "Talking with the other PMs can give good ideas and can find out about changes this way"
- "…Very good interaction with customers and good customer focus"

Recommendations: Overall project managers seem to like that they can do their jobs without interference, but I believe more standardization of the process used would be helpful. Also better interaction and idea sharing between the project managers is needed.

Discussion of Limitation

This paper discusses issues specifically related to the project manager processes used at the JNTF. Because not all of the JNTF project managers were included in the survey, additional useful information could be obtained by extending the survey to them.

Conclusions

The suggested areas for improvement are:

- Development and implementation of a Project Manager Certification Program. Part of PM certification should include attendance at ACQ 101. The second course ACQ 201 could be required after four years of experience as a project manager.

- Evaluate the usefulness of the SEMP and take the appropriate action to revise the SEMP continually or discontinue use of the SEMP.
- Better communication between the project managers through weekly PM meetings and team building exercises at work and outside of work.
- Use the Requirements Correlation Matrix as a way to track requirements throughout the project.
- Involve integral personnel at all critical steps to avoid confusion and redundancy.

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Appendix B

List of Project Manager Training Videos

TAPE #	OLD	NEW	Month	Topic #1	Topic #2	Topic #3	Topic #4
97-1		X	Mar-97	Award Fee Process	Project Managers Checklist	Finance/JOCAS	Fee for Service Environment
97-2		X	Apr-97	Roles, Responsibilities and Limitations			
97-3		X	May-97	EE/ROM Process	Task Order Process	Security	
97-4		X	Jun-97	Three Contract Types	Ethics and Standards of Conduct	Organizational Conflict of Interest	Inherent Government Function
97-5		X	Jul-97	Quality Principles	DD 250		
97-6		X	Aug-97	DD 1149 Process	CDRL Process		
97-8		X	Sep-97	Cost Performance Reporting/ JOCAS	Color of money	Forward Financing	Cost Estimating
97-9		X	Nov-97	Underrun Utilization	Bonafide Needs	More on CPR	
97-10		X	Dec-97	IMPAC Card	Contract Changes	QAE/PM Responsibilities with customers	
98-1		X	Mar-98	JNTF Directive 4200 - Task Order Process			
4	X		Feb-95	OSI	QAE	AFSPC Form 86	
5	X		Feb-95	AF Form 370	Master Surveillance Plan		

Replaced and not used		Not Yet Available	Current Tape for use.

Appendix C

DSMC Summer 1998 Schedule for ACQ 101 and ACQ 201

DSMC ACQ 101 Schedule for Summer 1998

START	FINISH	FULL?	SCHOOL	LOCATION
Jun 2	Jun 11	NO	DSMC	DSMC, Boston, MA
Jun 9	Jun 18	FULL	DSMC	FT Belvoir, VA DOD
Jun 16	Jun 25	NO	AFIT	USAF Instit of Tchnlgy, WRIG
Jun 16	Jun 25	NO	AFIT	Hanscom AFB, MA USAF
Jun 16	Jun 25	NO	AFIT	Kelly AFB, TX
Jun 16	Jun 25	FULL	ALMC	Philadelphia, PA NAVY
Jul 7	Jul16	NO	DSMC	DSMC FT Belvoir, VA
Jul 7	Jul16	NO	ALMC	ALMC, FT LEE VA
Jul 14	Jul 23	NO	NCAT	Patuxent River, MD NAVY
Jul 21	Jul 30	NO	DSMC	DSMC, Huntsville, AL
Jul 21	Jul 30	FULL	ALMC	Warren, MI ARMY
Jul 28	Aug 6	NO	AFIT	USAF Instit of Tchnlgy, WRIG
Jul 28	Aug 6	FULL	AFIT	Edwards AFB, CA USAF
Jul 28	Aug 6	NO	AFIT	Brooks AFB, TX USAF
Jul 28	Aug 6	NO	AFIT	Langley AFB, VA USAF
Aug 4	Aug 13	NO	DSMC	DSMC FT Belvoir, VA
Aug 4	Aug 13	FULL	DSMC	FT Monmouth, NJ ARMY
Aug 4	Aug 13	NO	NCAT	Robins AFB, GA USAF
Aug 4	Aug 13	NO	ALMC	ALMC, FT Lee VA
Aug 11	Aug 20	NO	DSMC	WPAFB, OH AF
Aug 18	Aug 27	NO	DSMC	EL Segundo, CA DOD

Aug 18	Aug 27	NO	ALMC	ALMC, FT Lee, VA
Aug 25	Sep 3	NO	AFIT	USAF Instit of Tchnlgy, WRIG
Aug 25	Sep 3	NO	AFIT	Kirtland AFB, NM USAF
Aug 25	**Sep 3**	**NO**	**AFIT**	**Peterson AFB, CO USAF**
Aug 25	Sep 3	NO	AFIT	Eglin AFB, FL USAF

DSMC ACQ 201 Schedule for Summer 1998

START	FINISH	FULL?	SCHOOL	LOCATION
Jun 2	Jun 19	NO	DSMC	DSMC, Los Angeles, CA
Jun 2	Jun 19	NO	DSMC	DSMC FT Belvoir, VA
Jun 2	Jun 19	NO	AFIT	USAF Instit of Tchnlgy, WRIG
Jun 2	Jun 19	NO	NCAT	Eglin AFB, FL USAF
Jun 2	Jun 19	NO	NCAT	Kelly AFB, TX
Jun 9	Jun 26	NO	DSMC	DSMC FT Belvoir, VA
Jun 9	Jun 26	FULL	DSMC	FT Monmouth, NJ ARMY
Jun 9	Jun 26	FULL	NCAT	Cherry Point, NC NAVY
Jun 29	Jul 17	NO	DSMC	DSMC FT Belvoir, VA
Jun 29	Jul 17	NO	DSMC	Huntsville, AL ARMY
Jul 7	Jul 24	NO	DSMC	DSMC FT Belvoir, VA
Jul 7	Jul 24	NO	AFIT	Point Mugu, CA NAVY
Jul 7	Jul 24	NO	NCAT	Dallas, TX DOD
Jul 14	Jul 31	NO	NCAT	Patuxent River, MD NAVY
Jul 21	Aug 7	NO	DSMC	DSMC FT Belvoir, VA

Jul 21	Aug 7	NO	NCAT	FT Meade, MD USAF
Jul 28	Aug 14	NO	DSMC	DSMC FT Belvoir, VA
Jul 28	**Aug 14**	**NO**	**NCAT**	**Peterson AFB, CO USAF**
Aug 4	Aug 21	NO	DSMC	Orlando, FL ARMY
Aug 4	Aug 21	NO	NCAT	Robins AFB, GA USAF
Aug 11	Aug 28	NO	DSMC	DSMC FT Belvoir, VA
Aug 11	Aug 28	NO	DSMC	Huntsville, AL ARMY
Aug 11	Aug 28	NO	AFIT	USAF Instit of Tchnlgy, WRIG
Aug 18	Sep 4	NO	DSMC	DSMC, Boston, MA
Aug 18	Sep 4	NO	DSMC	DSMC FT Belvoir, VA

Appendix D

Example SEMP Table of Contents for EIA/IS-632 Format

Example Table of Contents for a System Engineering Management Plan that follows EIA/IS-632 format from U.S. Air Force Flight Test Center ECIT Program Office, 412 TW/EWD (31 January 1995)

Table of Contents

1.0	Introduction
2.0	Technical Program Planning and Control
2.1	Program Overview
2.2	Program Organization
2.2.1	Management Authority
2.2.2	Functional Organizational Structure
2.2.2.1	System Program Director
2.2.2.2	Director of Engineering
2.2.2.3	Director of Acquisition Support and Control
2.2.2.4	Contracting Officer
2.2.2.5	Director of Operations & Services
2.2.2.6	Steering Committee
2.2.2.7	Configuration Control Board
2.2.2.8	Risk Management Board
2.2.2.9	Interface Control Working Group
2.2.3	Project Organization
2.3	Program Controls – Management
2.3.1	Work Breakdown Structure
2.3.1.1	Contract Work Breakdown Structure
2.3.1.2	Program Work Breakdown Structure
2.3.1.3	Work Packaging
2.3.2	Cost/Schedule Status Reports
2.3.3	Master Plans and Schedules
2.3.3.1	EPO Plans and Schedules
2.3.3.2	Contractor Plans and Schedules
2.3.4	Program Management Reviews/Technical Interchange Meetings
2.3.5	Design Reviews/Audits
2.3.5.1	Systems Requirements Review
2.3.5.2	System Functional Review
2.3.5.3	Software Specification Review
2.3.5.4	Preliminary Design Review
2.3.5.5	Critical Design Review
2.3.5.6	Test Readiness Review
2.3.5.6.1	Configuration Item TRR
2.3.5.6.2	Higher Level TRRs
2.3.5.7	Installation Readiness Review
2.3.5.8	Functional Configuration Audit
2.3.5.9	System Verification Review
2.3.5.10	Physical Configuration Audit

2.4 Program Controls – Technical
2.4.1 Technical Performance Measurement
2.4.1.1 Selection of Technical Performance Measurement Parameters
2.4.1.2 Assessment Methodology
2.4.1.3 Reporting and Documentation
2.4.2 Configuration/Change Control Procedures
2.4.3 Document Control/Data Management
2.4.4 Interface Control Management
2.5 Test and Evaluation Planning and Controls
2.5.1 Test & Evaluation Program Management
2.5.2 Developmental Test and Evaluation
2.5.3 Operational Test and Evaluation
2.6 Risk Management Program
2.6.1 Risk Planning
2.6.2 Risk assessment
2.6.3 Risk Analysis
2.6.4 Risk Handling
2.6.4.1 Risk Control
2.6.4.2 Knowledge and Research

3.0 Systems Engineering Process
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3.1.1 Requirements Analysis Objectives
3.1.2 Requirement Sources
3.1.3 Requirements Analysis Process
3.1.4 Hatley-Pirbhai Requirements Analysis
3.2 Functional Analysis/Allocation
3.2.1 Functional Analysis/Allocation Objective
3.2.2 General Functional Analysis/Allocation Process
3.2.3 Hatley-Pirbhai Requirements Model Process
3.3 Synthesis
3.3.1 Synthesis Objective
3.3.2 General Synthesis Process
3.3.3 Hatley-Pirbhai Architecture Model Process
3.4 Systems Analysis and Control Process
3.4.1 System Analysis
3.4.1.1 Trade Studies
3.4.1.2 System Effectiveness Studies
3.4.1.3 Cost Effectiveness Analyses
3.4.2 Technical Coordination and Control
3.4.3 Compliance Verification

4.0 Engineering Specialty Integration
4.1 Security
4.2 Human Engineering
4.3 System Safety

4.4 Reliability/Maintainability
4.5 Fault Tolerance
4.6 Electromagnetic Compatibility

5.0 Applicable Documents

6.0 Acronyms

List of Figures

List of Attachments

Appendix E

Attachments 7 and 8 from AFI 10-601

Attachment 7

OPERATIONAL REQUIREMENTS DOCUMENT (ORD) (PROCEDURES AND FORMAT)

Section A7A—ORD Procedures

A7.1. Procedures in Preparing an ORD. The ORD is a formatted statement that contains performance (operational effectiveness and suitability) and related operational parameters for the proposed concept or system. This attachment contains DoD and Air Force guidance on how to prepare an ORD. Relevant information in an ORD will vary based on specific subject matter and maturity of a program. An ORD I, for example, will contain only basic, limited information required for a MS I decision. Later milestones will need a much higher level of detail as system-specific information becomes known. A requirements correlation matrix (RCM) is a mandatory attachment to all Air Force and Air Force-lead ORDs (see attachment 8 for RCM procedures and format). ***NOTE:*** System Operational Requirements Document (SORD) to ORD conversion policy: SORDs for existing programs must be reaccomplished in the ORD format before the next scheduled Milestone decision. SORDs for programs that have not proceeded beyond Milestone II: Convert SORDs to ORDs prior to the Milestone II decision. SORDs for programs beyond Milestone II: If the MS II decision was prior to August 1991, MAJCOMs may update the existing SORD between Milestone decision points as necessary. However, if the SORD is updated, the RCM must be reaccomplished to comply with the format specified in attachment 8 of this instruction. All programs must convert SORDs to the ORD format to support a MS III decision. SORDs for programs beyond MS III: SORDs may be updated as necessary; however, the RCM must be reaccomplished to comply with the format specified in attachment 8 of this instruction. In order to facilitate the staffing and approval process, it is highly recommended that the latitude for updating SORDs, instead of converting to an ORD, be invoked by the user only for minor changes. The staffing and approval process for SORD updates is the same as described in paragraphs A7.2.1, A7.2.2, and A7.2.3. However, CSAF approval for SORD updates is required only for significant requirements changes (as determined by HQ USAF/XOR).

A7.1.1. Each concept proposed at MS I, Concept Demonstration Approval, for continued evaluation during Phase I, *Demonstration and Validation*, will be described in the ORD in terms of system characteristics and capabilities that define the system needed to satisfy the MNS. Use the following descriptions/definitions of terms to assist in developing the requirements:

A7.1.1.1. MOEs should be developed to quantify how well alternatives satisfy the operational need qualitatively described in the MNS. These MOEs should be developed during the Phase 0 COEA process and should be included in the ORD. MOEs play a vital part in linking the COEA, APB, ORD, and TEMP. Since MOEs are rarely amenable to end-to-end tests, the capabilities (MOP) and characteristics (design features) in the initial and subsequent ORDs should be refined to a level of specificity that allows development and operational testing to assess system effectiveness. (CJCS MOP 77).

A7.1.1.2. The **system characteristics and capabilities** in the ORD will be tailored to the concept (e.g., satellite, aircraft, missile, weapon, etc.) and will reflect system-level performance characteristics and capabilities. Applicable environmental conditions will also be identified.

A7.1.1.2.1. System capabilities are measures of performance such as range, lethality, maneuverability, etc.

A7.1.1.2.2. System characteristics are design features such as weight, size, shape, etc.

A7.1.1.2.2.1. Critical system characteristics are a special category of characteristics that are historically design, cost, and risk drivers; and therefore, they require early identification to facilitate cost and risk reduction and cost-performance tradeoffs. Critical system characteristics include such areas as electromagnetic pulse hardening, energy efficiency, transportability, interoperability, stealth, electronic counter-countermeasures (ECCM), etc. (See DoD Instruction 5000.2/Air Force Supplement 1 and paragraph 4c, section B, this attachment.)

A7.1.1.3. A **threshold** is a minimum acceptable operational value for a system capability or characteristic which, in the user's judgment, is necessary to provide an operational capability that will satisfy the mission need (DoD Instruction 5000.2/Air Force Supplement 1).

A7.1.1.4. An **objective** is a value beyond the threshold that could potentially have a measurable, beneficial impact on capability or operations and support above that provided by the threshold value (e.g., additional range that might reduce the number of refueling systems required) (DoD Instruction 5000.2/Air Force Supplement 1). An objective value may be the same as the threshold when an operationally significant increment above the threshold is not identifiable or useful.

A7.1.1.5. Key performance parameters describe those capabilities and characteristics, including selected critical system characteristics, so significant that failure to meet the threshold is cause for the concept or system to be reevaluated or the program to be reassessed or terminated (DoD Instruction 5000.2/Air Force Supplement 1 and CJCS MOP 77). **Key performance parameters are extracted from the ORD and are included in the performance section of the APB at each milestone.** Considerations for identifying key performance parameters are:

- They must be important.
- They must be warfighting oriented.
- They must be measurable, achievable (realistic), and testable.
- The numbers and percentages must be explainable by analysis.
- They must be in the ORD and the Acquisition Program Baseline.
- The user must be willing to consider cancelling the program if the threshold is not met. (Source: JROC Secretariat)

A7.1.2. The ORD will be updated and expanded for MS II, *Development Approval*, to include thresholds and objectives for more detailed and refined performance capabilities and characteristics which are based on the results of tradeoff studies and testing conducted during Phase I, *Demonstration and Validation*.

A7.1.2.1. After MS II, the ORD will be modified only as a result of a change in the MNS or cost-schedule-performance tradeoffs conducted during Phase II, *Engineering and Manufacturing Development*.

A7.1.2.2. Key performance parameters extracted from the ORD will be included in the performance section of the Development Baseline (APB) at MS II and the Production Baseline (APB) at MS III.

A7.1.3. The ORD will be used to develop contract specifications during each acquisition phase.

A7.2. Preparation and Submission. HQ USAF/XOR will direct preparation of the initial ORD in the concept study PMD which assigns responsibilities, directs actions, and assigns suspenses. The using command is normally the OPR for the ORD. The OPR will prepare the first ORD (consistent with COEA accomplishment) during Phase 0, Concept Exploration and Definition, for one or more preferred concepts to be proposed at MS I. The OPR will work with the OCRs at the supporting, implementing, and participating commands as well as designated test agency to produce the ORD.

A7.2.1. Review and Staffing. After developing the draft ORD, the OPR will conduct a draft "for comment" phase, by distributing the ORD according to attachment 9 for Air Force-wide review. Use the applicable cover sheet (attachment 4) and a command transmittal letter to include relevant ORD control information, to identify the potential ACAT level, and any other amplifying instructions or information pertinent to the document (e.g., backfill document, SORD to ORD conversion only, document being prepared for Milestones I, II, and III combined, etc.) HQ USAF/XOR will obtain HQ USAF and SAF directorate level (2 star) review. The comments obtained during HQ USAF and SAF review will be consolidated and forwarded to the ORD originator, normally within 45 days from receipt of the document. These comments will be qualified as critical, substantive, or administrative. Failure to address critical comments may be cause for nonconcurrence on the final document. Substantive comments should be addressed, but failure to do so will not necessarily result in nonconcurrence on the final document. Air Force-wide addressees must respond to the originator within 45 days from receipt of the document. After completing the draft "for comment" phase, the ORD originator must update the ORD, to include relevant inputs, and forward the final document (without the MAJCOM or using commander's signature) to HQ USAF/XORJ under appropriate command transmittal letter. The ORD must be accompanied by the disposition of each of the critical and substantive comments made by HQ USAF and SAF agencies during the draft "for comment" review. HQ USAF/XOR will obtain final Deputy Chief of Staff level coordination on the document, normally within 30 days from receipt of the document, and notify the originator that the final document is ready for validation and submission for CSAF approval.

A7.2.2. Validation and Approval. Upon notification that the final document is ready to submit for CSAF approval, the applicable MAJCOM or originator will validate the ORD by obtaining the commander's signature on the cover sheet (attachment 4). MAJCOMs or originators then forward the ORD to HQ USAF/XORJ to submit for CSAF approval, normally obtained within 15 days from receipt of the MAJCOM-validated document. HQ USAF/XOR will forward a copy of the CSAF approved document and approval memorandum to the ORD originator.

A7.2.3. ORD originators will send CSAF-approved ORDs to the applicable organizations listed at attachment 9. After publication, the OPR will not change the ORD without coordinating with the applicable OCRs. *NOTE:* **Any changes to an approved ORD and RCM must be resubmitted for HQ USAF review and may require CSAF approval (dependent on the level or impact of the change).**

A7.2.4. Preparation, review, coordination, and approval for subsequent ORDs or ORD updates will normally be the same as for the first ORD. The OPR will update the ORD before and, if necessary, after Milestone and Summit reviews.

A7.3. ORD Numbering. In order to provide linkage and traceability, the ORD title will contain the same number as assigned to the MNS to which it responds, with the addition of the Milestone number for which the ORD is being prepared. (Example: CAF MNS 001-XX requires a CAF ORD 001-XX-I for a MS I

decision. Subsequent ORDs prepared for Milestones II and III would be numbered CAF ORD 001-XX-II and CAF ORD 001-XX-III, respectively. If there are several different projects or programs generated from the same MNS, initiators will identify the subsequent requirements documents as described above with the addition of the suffixes A, B, etc., to separate each project (CAF ORD 001-XX-IA and CAF ORD 001-XX-IIB). Documents being revised between Milestone decisions should be identified as CAF ORD 001-XX-I (Revision 1, January 19, 199X). If the initial ORD is being prepared for a program going directly from a MS 0 to MS II or III, the ORD should be numbered CAF ORD 001-XX-I/II for a MS II decision or CAF ORD 001-XX-I/II/III for a MS III decision.

Section A7B—ORD Format

A7.4. This attachment includes DoD and Air Force guidance. Note: An asterisk (*) denotes Air Force guidance.

OPERATIONAL REQUIREMENTS DOCUMENT (ORD) FOR (PROGRAM TITLE)

1. General Description of Operational Capability:

a. Describe the mission area, the type of system proposed, and the anticipated operational and support concepts in sufficient detail for program and logistics support planning. Include a brief summary of the MNS and identify it by the assigned MAJCOM number. If a MNS did not precede the ORD, explain the source directing the effort or program and, if applicable, the process that investigated alternatives for satisfying the mission need and developing operational requirements. If the program was top-down directed, state that fact and the directing organization.

*b. The user must prepare a Requirements Correlation Matrix (RCM) as an attachment to the ORD. (See attachment 7 for RCM procedures and format.)

2. Threat:

a. Identify potential enemy capabilities--doctrine, strategy, tactics, organization, equipment and military forces--that could defeat, degrade, or destroy proposed concept or system effectiveness. Summarize the threat and threat environment based on DIA projections that extend 10 to 20 years in the future. The ORD threat assessment will contain the following sections: Operational Threat Environment, System Specific Threats (at IOC and IOC plus 10 years), Reactive Threats, and Targets (if applicable).

b. For major defense acquisition programs (ACAT I), reference the HQ USAF/IN approved and DIA validated System Threat Assessment Report (STAR). In some nonwarfighting systems, the threat may be listed as not applicable. *The STAR addresses operational threats to a resource (such as a surface-to-air missile threat to a fighter) as well as threat countermeasures. The STAR must include the operational threat and the ground threat posed by terrorists and other opposing forces.

3. Shortcomings of Existing System. Describe why existing systems cannot meet current or projected requirements (do not describe a proposed system).

4. Capabilities Required. This section should describe, in operational terms, the required system performance capabilities and characteristics. The measures of effectiveness and the related MOPs identified during Phase 0 concept studies or the COEA process should also be included in this section of the ORD. At MS I, the ORD may be brief, with some capabilities and characteristics to be determined and subject to later refinement. Consider all elements and subsystems to develop a total integrated systems approach. Specify each capability and characteristic in terms of a threshold value required to satisfy the mission need and an objective value. Capabilities and characteristics with threshold values are eligible for inclu-

sion in the performance section of the Acquisition Program Baseline (APB) as key performance parameters; for testing during development, test, and evaluation (DT&E); and for testing during operational test and evaluation (OT&E). These values will be weighed against what is operationally acceptable and what is considered technically achievable while providing the program manager as much latitude and flexibility as possible.

a. System Performance:

(1) Include system performance parameters such as mission planning needs, range, accuracy, payload, speed, mission reliability, etc. Describe mission scenarios (wartime and peacetime, if different) in terms of mission profiles, employment tactics, and environmental conditions (all inclusive: natural and man-made [i.e., weather, countermeasures, ocean acoustics, etc.]).

*(2) Cite the SEEK EAGLE (SE) needs and requirements the new aircraft and (or) stores must have (see attachment 11, for SE definition). Identify the items of critical information (capabilities and limitations of weapon systems to be controlled or protected from enemy intelligence collection).

b. Logistics and Readiness. Include measures for mission capable rate, operational availability, frequency and duration of preventive or scheduled maintenance actions, etc. Describe in terms of mission requirements, considering wartime and peacetime logistics operations. Identify combat support requirements, including battle damage repair capability, mobility requirements, expected maintenance manpower and skill levels, and surge and mobilization capabilities. *AFI 10-602 provides specific guidance on defining these requirements.

c. Critical System Characteristics. As a minimum, and where applicable, address ECCM and Wartime Reserve Modes (WARM) requirements; conventional, initial nuclear weapons effects, and nuclear, biological, and chemical (NBC) survivability; natural environmental factors (such as climatic, terrain, and oceanographic factors); and electromagnetic compatibility and frequency spectrum assignment for systems operating in the electromagnetic spectrum. Define the expected mission capability (i.e., full, percent degraded, etc.) in the various environments and for the applicable threat scenarios. Include applicable safety parameters related to system, nuclear, explosive, and flight safety. Identify communications, information, and physical and operational security needs. (Selected critical system characteristics may be included as key parameters in the performance section of the APB.)

*Identify arms control treaty compliance requirements.

5. Integrated Logistics Support (ILS). Establish organizational, intermediate (if required), and depot level support objectives for initial and full operational capability (AFI 10-602). *The OPR and supporting command OCR will develop and expand ILS requirements and planning in the Integrated Logistics Support Plan (ILSP) and collect and process ILS information in the Logistics Management Information System (LMIS). ILS planning will be accomplished at the subsystem level for each acquisition.

a. Maintenance Planning. Identify maintenance tasks to be accomplished and time phasing for depot maintenance, including programmed depot maintenance and surveillance inspections such as nuclear hardness and structural integrity. Describe the planning approach for contract versus organic repair. Develop maintenance concepts, using Repair Level Analysis (RLA) trade studies. Determine maintenance strategy for reparable, commercial nondevelopmental items (NDI).

b. Support Equipment. Standard support equipment to be used by the system will be defined, maximizing the use of commercial NDIs and families of automated test equipment (ATE). Test and fault isolation

capabilities desired of automatic test equipment will be described at all levels, expressed in terms of realistic and affordable probabilities and confidence levels.

c. Human Systems Integration (HSI). The operational and maintenance training concept (pipeline, training devices, embedded training and onboard training, interactive courseware) will be briefly described. Identify manpower, personnel, and training constraints. Establish objectives and thresholds, if applicable, for manpower (force structure and end strength), personnel (numerical and skill level), training, and safety. Specify manpower and training methodologies to be used (i.e., HARDMAN).

d. Computer Resources. Identify computer resource constraints (examples include language, computer, data base, architecture, or interoperability constraints). Address mission critical and support computer resources, including automated test equipment. Describe the capabilities desired for integrated computer resources support. Identify any unique-user interface requirements, documentation needs, and special software certifications.

e. Other Logistics Considerations. Describe the provisioning strategy for the system. Specify any unique facility and shelter requirements. Identify special packaging, handling, and transportation considerations. Define unique data requirements such as engineering data for depot support and technical orders for the system and depot. *Include Computer-aided Acquisition Logistics Support (CALS) requirements for technical data. Identify the use of, and minimize need for hazardous materials. For additional information, see AFPD 21-3, AFPD 24-6, AFR 71-1, and AFR 80-18.

6. Infrastructure Support and Interoperability. Discuss interfacing systems (at the system or subsystem, platform, and force levels), specifically those related to command, control, communications, and intelligence (C3I), transportation and basing, and standardization and interoperability. Identify companion ORD and other Services that may have similar requirements. **Include the joint potential designator (joint, joint interest, or independent) established during the Service harmonization process (see paragraph 3.7)***NOTE:* HQ USAF/XOR will pass the joint potential designation to J-7.

a. Command, Control, Communications, and Intelligence. Describe how the system will be integrated into the C3I architecture forecasted to exist at the time the system will be fielded. Include data requirements (data, voice, video), computer network support, and antijam requirements. Identify unique intelligence information requirements, including intelligence interfaces, communications, and data base support that pertain to target and mission planning activities, threat data, etc. *Reference the system's intelligence support requirements in the ISP as a complement to operational requirements in the ORD (see AFIs 14-208 and AFI 33-102). Describe the electromagnetic spectrum resources required by the system (e.g., general location in the spectrum, bandwidth required).

b. Transportation and Basing. Describe how the system will be moved either to or within the theater. Identify any lift constraints. Detail the basing and associated facilities available for training locations and main and forward operating bases.

c. Standardization, Interoperability, and Commonality. Describe considerations for joint use, NATO cross-servicing, etc. Identify procedural and technical interfaces as well as communications, protocols, and standards required to be incorporated to ensure interoperability with other Service, joint Service, and Allied systems. Address energy standardization and efficiency needs for both fuels and electrical power, as applicable. *Address system power conversion and surge protection requirements envisioned for the operating environment.

d. Mapping, Charting, and Geodesy Support. Identify cartographic materials, digital topographic data, and geodetic data needed for system employment. Where possible, Defense Mapping Agency (DMA)

standard military data will be used. **NOTE:* Use current World Geodetic System Datums (i.e., WGS 84). For waiver approval, contact HQ USAF/IN.

e. Environmental Support. Identify the standard and unique weather, oceanographic, and astrogeophysical support required. Include data accuracy and forecast requirements.

7. Force Structure. Estimate the number of systems or subsystems needed, including spares and training units. Identify the platforms and quantities of these platforms (including other Services' or Government agencies', if appropriate) that will employ the systems or subsystems being developed and procured to satisfy this ORD. * Force structure estimate will include numbers of systems sufficient for gained reserve component (Air National Guard and Air Force Reserve) forces under AFI 10-301.

8. Schedule Considerations. Define what actions, when complete, will constitute attainment of IOC and FOC (provide flexibility for these to be revised as the program is progressively defined and tradeoff studies are completed). Clearly specify the operational capability or level of performance necessary to declare IOC and FOC. Include the number of operational systems, operational and support personnel, facilities, and organizational, intermediate, and depot support elements that must be in place. If availability in a specific timeframe is important, specify an objective for IOC declaration. Describe the impact if this objective is not achieved and identify a window of acceptability, if appropriate. *The required actions and desired dates to attain IOC should include RAA date, projected trial period, required organic support capability dates, etc. The actual IOC declaration should be viewed as an event rather than a calendar date (paragraph 7, basic text).

Attachment 8

ORD REQUIREMENTS CORRELATION MATRIX (RCM) (PROCEDURES AND FORMAT)

Section A8A—RCM Procedures

A8.1. The Requirements Correlation Matrix (RCM) is a mandatory attachment to all Air Force ORDs. The operating command is responsible for preparing the RCM. *NOTE:* **It is critical that the definitions listed in attachment 7 (ORD Procedures), paragraph A7.1.1 be thoroughly reviewed before developing the RCM.**

A8.2. The purpose of the RCM is:

- To provide Air Force senior leadership a summary of the user's operational requirements and the supporting rationale.
- To document the evolution of the user's operational requirements as the system matures and the rationale for any changes.
- To provide a tool to identify user-nominated key performance parameters for inclusion in the performance section of the Acquisition Program Baseline (APB). The RCM contains system operational characteristics and capabilities quantified by thresholds, as appropriate, and desired objectives as defined in the ORD.

RCMs are not to be used or viewed as stand-alone documents. The operational characteristics and capabilities contained in the RCM serve as the foundation for developing the System Maturity Matrix (SMM) by the implementing command and the APB.

A8.3. The RCM is a three-part attachment that consists of a Requirements Correlation Matrix, Part I; a *Supporting Rationale for System Characteristics and Capabilities Sheet*, Part II; and a *Rationale and Needs/Requirements Change Sheet*, Part III.

A8.3.1. RCM Part I, Requirements Correlation Matrix (figure A8.1). The RCM Part I will include:

- A tabular summary of the operational requirements included in paragraph 4 of the ORD text (i.e., the capabilities and characteristics for system performance, logistics and readiness, and critical system characteristics, with their associated thresholds and objectives).
- Other quantifiable, operationally significant, requirements (not specifications) from elsewhere in the ORD that help define the system, as deemed appropriate by the user.
- All key performance parameters recommended by the user for inclusion in the performance section of the APB. The characteristics and capabilities listed in the RCM for ORD I will likely be few in number.

As the system matures and becomes better defined, sub-elements or new characteristics and capabilities may be added. While new items add better definition, they may also limit the program director's flexibility. A threshold is a minimum acceptable operational value for a system capability or characteristic which, in the user's judgment, is necessary to provide an operational capability that will satisfy the mission need (DoD Instruction 5000.2/Air Force Supplement 1). An objective is a value beyond the threshold that could potentially have a measurable, beneficial impact on capability or operations

and support above that provided by the threshold value (e.g., additional range that might reduce the number of refueling systems required) (DoD Instruction 5000.2/Air Force Supplement 1). A definition of each column follows:

A8.3.1.1. System Capabilities and Characteristics Column. List the system's general operational characteristics and capabilities outlined in the ORD, consistent with paragraph A8.3.1, that are realistic, meaningful, and germane to the mission need, including mission planning requirements. Adjacent to each capability and characteristic, reference the paragraph in the ORD text from which it came. Characteristics and capabilities will vary depending on the type of system being described; they should generally include, but are not limited to, areas such as speed, range, accuracy, payload, probability of kill, capacity, survivability, reliability and maintainability, mission capable rates, frequency and duration of preventative or scheduled maintenance action, operational effectiveness, and suitability. They should be necessary for successful operational mission accomplishment.

A8.3.1.2. Thresholds and Objectives Columns Supporting Milestones I Through IV.

Include the threshold and objective values for each of the characteristics and capabilities listed in the System Capabilities and Characteristics Column. As the program matures and needs evolve into firm thresholds and objectives (vice TBDs), these columns will reflect system-specific performance and support values agreed to by the using, implementing, and supporting commands. These thresholds and objectives normally will form the basis for contractual specifications. The value for each threshold must be referenced in Part II, describing its relationship to mission success and how that value was derived. When a threshold or objective changes from an earlier ORD iteration, explain and give the rationale for the change in Part III of the RCM.

A8.3.1.3. Key Performance Parameters. Any characteristic or capability with an associated threshold is a candidate for a key parameter and inclusion in the APB. The operating command should recommend key performance parameters for inclusion in the APB by marking the specific capability and (or) characteristic with an asterisk (*) as indicated in figure A8.1. Key performance parameters must have threshold and objective values (objectives may be the same as the thresholds when an operationally significant increment above the threshold is not identifiable or useful). *NOTE:* According to DoD 5000 series directives, the Milestone Decision Authority approves the APB and may, therefore, add additional key parameters to the APB during the milestone decision process.

A8.3.2. RCM Part II, Supporting Rationale for System Characteristics and Capabilities Sheet (figure A8.2). Cite specific studies, analyses, threat assessments, modeling, or other reference sources (including informed military judgments) that justify and substantiate thresholds for each system characteristic or capability.

A8.3.3. RCM Part III, Rationale and Needs/Requirements Change Sheet (figure A8.3). Show the rationale for changes in system characteristics, performance, and supporting parameters, etc. As appropriate, cite the report title, document number, supporting analysis, get-well date, and schedules, etc. (Example shows the evolutionary process of refining characteristics and capabilities.)

Section A8B—RCM Format

A8.4. The following paragraphs illustrate the RCM format.

(EXAMPLE)

RCM PART I:

Figure A8.1. RCM Part I Format.

REQUIREMENTS CORRELATION MATRIX

PART I **As of Date:: 4 July 19XX**

SYSTEM CAPABILITIES AND CHARACTERISTICS	ORD I		ORD II		ORD III	
	Thresholds	Objectives	Thresholds	Objectives	Thresholds	Objectives
1. Non-Afterburner Supersonic Cruise (4.a.(1))						
a. Sustained Speed *	1.50M	1.50M	1.7M	2.0M	1.5M	2.0M
b. Dash	TBD	>1.5M	2.1M	2.4M	2.1M	2.4M
2. Radar Search and Track (4.a.(2))						
a. Search (No. of Targets) *	6	12	6	16	6	16
b. Track (No. of Targets)	TBD	6	4	8	4	8
c Search Range (NM) *	100	250	150	200	150	200
d Track Range (NM)	TBD	125	50	100	50	100
3. Weapons Compatibility (4a.(2))						
a. Air-to-surface (Load)	CBU-87, 89 (4) AGM-137 (2) JDAM I (2)	CBU-97 (4) MK 62 Mine (6) JDAM III (2) AGM-88 (4)	CBU-87, 89 (4) AGM-137 (2) JDAM I (2)	CBU-97 (4) MK 62 Mine (6) JDAM III (2) AGM-88 (4)	CBU-87, 89 (4) AGM-137 (2) JDAM I (2) AGM-88 (4)	CBU-97 (4) MK 62 Mine (6) JDAM III (2)
b. Air-to-air (Load) *	AIM-120 (4) AIM-9M (4)		AIM-120 (4) AIM-9M (4)		AIM-120 (4) AIM-9M (4)	
4. Terrain Following (TF) Min Altitude (Ft) (4.a.(3)) *	100 ALL WX	100 ALL WX	100 ALL WX	100 ALL WX	200 ALL WX	100 ALL WX
5. Operational Availability (4.b.(1))	85 %	90 %	21 Hrs/day	22 Hrs/day	21 Hrs/day	22 Hrs/day
6. BIT False Alarm Rate (4.b.(2))	10 %	5 %	10 %	1 %	10 %	1 %
7. Radar Cross Section (m2) (4.c.(1)) *	3	1	3	1	3	1
* = Key Performance Parameter						

Notes:

1. Place an asterick (*) adjacent to each specific capability or characteristic the user wishes to be a key performance parameter to be placed, along with its associated threshold and objective, in the performance section of the APB.
2. Adjacent to each capability and characteristic listed in the RCM, reference the appropriate ORD paragraph from which it came.
3. Avoid the use of "YES" thresholds; instead depict the requirement as shown in the weapons compatiblility example.

RCM PART II:

Figure A8.2. RCM Part II Format.

(EXAMPLE)

REQUIREMENTS CORRELATION MATRIX

Part II

(Supporting Rationale for System Characteristics and Capabilities)

AS OF DATE: 4 Jul 19XX

Parameter 1--Non-Afterburner Supersonic Cruise. Tactical Fighter Weapon Center Study 7X-XXX, 15 Jan XX, concluded new fighter must have capability to engage targets at supersonic speeds after flying over enemy territory for XXXX miles. Consequently, aircraft must have supersonic cruise without resorting to high fuel consuming afterburners.

Parameter 2--Radar (Fire and Forget Capable). DIA Report #XX-123-X-90 (S/NF) states that in the next 15 years potential adversaries will own more third-generation Former Soviet Union (FSU) fighters than the number of fighters operated by the United States. To mitigate the numbers difference during an engagement, the F-YY must be able to launch multiple missiles and immediately begin maneuvering. It will not be able to provide missile guidance signals. Therefore, the F-YY must be designed to accept air-to-air missiles that independently track their targets after release.

Parameter 3--Weapons Compatibility. The Air Combat Command (ACC) Study "Future Look Fighter," dated 15 Aug XX, identifies next generation fighter standard air-to-surface and air-to-air munitions compatibility and loads (excluding MK series munitions) consistent with the specified threshold requirements.

Parameter 4--Terrain Avoidance (TA)/Terrain Following (TF). The Air Combat Command (ACC) Study "Future Look Fighter," dated 15 Aug XX, states next generation fighter must be capable of penetrating enemy airspace in weather conditions expected XX% of the time, at altitudes no higher than 200 AGL. The high combat workload in a single-seat aircraft mandates an automatic TF system.

Parameter 5--Operational Availability. Operational availability values are based on projected wartime sortie requirements as documented in OPLAN XXX.

Parameter 6--BIT False Alarm Rate. AFPD 10-XX establishes BIT false alarm rates for next generation aircraft will not exceed 10 percent.

Parameter 7--Radar Cross Section. DIA Report #XX-123-X-90 (S/NF) predicts the probability of potential adversaries next generation fighter air-to-air radar capability and future surface-to-air tracking radar capability to track a 3m2 target inside lethal missile launch range to be less than 10 percent. The probability of the adversaries' to detect and track a 1m2 target inside lethal missile range is predicted to be virtually nil.

RCM PART III:

Figure A8.3. RCM Part III Format.

(EXAMPLE)

REQUIREMENTS CORRELATION MATRIX

Part III

(Rationale & Needs/Requirements Changes)

AS OF DATE:

Parameter 1a. Sustained non-afterburner supersonic cruise speed (M) reduced from 1.7M to 1.5M. Reduction due to cost-performance tradeoff conducted by contractor at direction of program office on 9 Apr XX. Accepted by HQ ACC as final threshold on 14 May XX.

Parameter 3a. AGM-88 HARM weapons compatibility moved from objective to threshold for this Milestone III ORD due to the addition of lethal suppression of enemy air defenses as a primary mission for the F-YY.

Parameter 4. Automatic terrain following (ATF) contour threshold raised from 100 feet AGL to 200 feet AGL in weather (WX) conditions expected XX% of the time. Increase is result of technical problems in ATF radar processor. The error rate for climb commands (clutter problems) is unacceptable at 100 feet, and there is no known, cost-effective technical fix. Change proposed by contractor on 6 Feb XX and accepted by HQ ACC on 15 Apr XX. Program office revised contract specifications on 20 May XX. Identified as a Key Performance Parameter in this Milestone III ORD to indicate that any additional increase in ATF contour is unacceptable to the user. Addition of this key performance parameter validated by the Joint Requirements Oversight Council (JROC). Operational impact is negligible because of smaller than expected front aspect radar cross section.